MONTHLY PROGRESS REPORT
Slurry/Micro-Surface Mix Design Procedure
September 2003

To:	**T. Joe Holland, CALTRANS**
Contract No.:	**CALTRANS 65A0151**
Contract Period:	**June 30, 2003 – Nov. 30, 2007**
Agency:	**Fugro-BRE, Inc.**
Prepared By:	**Jim Moulthrop, Principal Investigator**
Date Prepared:	**October 16, 2003**

CURRENT MONTH WORK ACTIVITIES AND COMPLETED TASKS

PHASE I LITERATURE SEARCH AND WORK PLAN DEVELOPMENT

Task 1 – Literature Review and Industry Survey

Literature Review

The literature review process continued this month with more documents from the initial list of references being reviewed and summarized in a first draft literature review report. As suggested by members of the research team and by the state agencies involved in this project, new references have been added to the list and will be included in the final Task 1 report. An updated list of references and their status is provided in Table 1.

At this stage, the ASTM D 3910 and D 6372 standards have been reviewed and summarized. The review of the ISSA Performance Guidelines A105 and A143 is also completed. In progress is the review of the Texas Transportation Institute (TTI) reports (0-1289-1 & 1289 2-F) that contain performance data specific to experimental sites where microsurfacing and slurry systems were used.

Other documents already reviewed include several papers by Robert C. Benedict, and the German and French standards for slurry seals and microsurfacing systems.

As outlined in the proposal the draft literature review report is organized under the following headings:

- Introduction
- Extent of Use Worldwide
- Current Mix Design Procedures
- Laboratory Tests
- Critical Factors that Relate to Performance
- Performance of Existing Projects
- Existing Guidelines and Specifications
- Failure Modes
- Benefits and Limitations

- Intended Use and Expectations
- Proposed Framework for Performance Based Design Procedure
- References

Table 1. Literature Sources

Source	Available	Reviewed
ASTM D3910-98 and ASTM D6372-99 Practice for Design, Testing and Construction of Micro-surfacing	Yes	Yes
ISSA procedures for Slurry Seal Mix Design (A105) and Micro-surfacing (A143)	Yes	Yes
TTI Reports 0-1289-1 & 1289 2-F	Yes	In Progress
International Slurry Surfacing Association Conference Proceedings	Yes	In Progress
Papers by Robert C. Benedict	Yes	In Progress
Transportation Research Board Publications, Research in Progress	Yes	
European Standards EN 12274-1 to 12274-8 Slurry surfacing Test methods Part 1 to Part 8.	No	
Transportation Research Laboratory Standards (UK)	Yes	
Austroads – Guide to the Selection and Use of Bitumen Emulsions	Yes	
German Standards	Yes	Yes
French Standards	Yes	Yes
CALTRANS Slurry Study	Yes	
Technical Guideline: The use of Modified Bituminous Binders in Road Construction. Asphalt Academy c/o Transportek, CSIR	Yes	

Literature Review Database

As mentioned in the previous monthly report, most of the data reviewed during the literature search is stored in a Microsoft Access database, for easy access and use in the later phases of the project. Database population activities continued this month especially with performance data from the TTI reports.

Industry and Agency Surveys

Following our discussion with members of the team and CALTRANS, three surveys were designed: 1) one for agencies, using the AASHTO LISTSERVE link, 2) one for contractors and manufacturers in the United States and the international slurry surfacing and microsurfacing industry, and 3) one for the advisory panel contractors. The three proposed survey questionnaires were included in the first monthly report and discussed at the videoconference kickoff meeting on September 22, 2003. Minutes of the videoconference and the list of attendees are included in Attachment A. In Attachment B, the comments and suggestions of the participants at the videoconference are included. Based on these comments the three questionnaires have been revised and they are included in their final form in Attachment C.

The three questionnaires (in the form shown in Attachment C) will be sent to the intended recipients this month.

With the occasion of the ISSA Board of Directors Meeting held in Austin, on October 9, the PI had the opportunity to present to the ISSA directors the same presentation that was discussed in the videoconference kickoff meeting. The comments and suggestions of the board were noted.

Task 2 – Work Plans for Phases II and III

One of the work activities that we pursued under this task was in the review of potential test methods for slurry seal mix design. The emphasis was on a humidity variation of the wet cohesion test for potential use in examining curing characteristics under humidity, night, and low temperature conditions.

Continuing discussions took place between Mr. Holleran and Ms. Goldman regarding the development of the Phase II Work Plan. The provisional outline of the Phase II experimental plan is presented below:

Step 1 Materials Testing

- Aim is to screen materials to allow agency to check correct materials were used.
- No changes for aggregate testing or specification at this stage.
- Binder: recovery method to be set at ASTM vacuum distillation and/or Caltrans method.
- Binder spec to be on base binder and DSR results for 10C and 35C to establish thermal susceptibility only (measure G*sin Delta for the existing commercial range of emulsion binders).
- Establish minimums for recovered binder and allow a max percentage change to account for degradation and or hardening.
- Wet stripping TB 114 would be retained.

Step 2 Mixing Characteristics

- Trial mixes using hand mixing as per existing TB 113.
- German mix cohesion testing on selected mixes to establish a mixing index that will allow use at given temperatures and humidity on standard equipment (this will require standard mixtures being used from known acceptable field mixes).
- Workability Index: This will be based on consistency and spreadability of the mix in a spreader box under different conditions and a cohesion set as an endpoint that is a maximum at a given time.

Step 3 Cohesion Build Up after Spreading

- The modified sample preparation protocols to take into account night, humidity, and temperatures of cure.
- Modified TB 139 with a new machine measuring torque instrumentally with application of force and response measured either in compression or with confined samples in rubber.
- Test would define:
    - Cohesion at trafficability
    - Cohesion at 24 hours
    - Optimum binder content
- Wet Track Abrasion test with French wheel modification. Consideration will be given to looking at low temperature testing and higher temperature testing. Load variations on

the wheels could be used for higher traffic simulations. Variable cure conditions may too be used. Maximum losses would need to be established.

- Modified loaded wheel type and sand adhesion tests. Bleeding is normally due to errors or failing to take temperature and traffic into account; this will be avoided by incorporating variable conditions of load and temperature in this test.

Step 4 Long Term Tests

- The main failure modes of abrasion would be addressed:
  - Cracking
  - Rutting
  - Water
- Abrasion WTAT – French Test with different treatments such as soaking for water resistance.
- Rutting: Wheel tracking test with water.
- Cracking Fatigue on section about 40-50mm (strain controlled).
- Testing would be done for High low and medium.
  - Traffic (loading)
  - Temperature
  - Humidity

Step 5 Field Type Tests

- Field Cohesion – by measuring a resistance to penetration or a sharing torque. This would be for traffic time and for use after 24 hrs. Results would NOT be mix design parameters, but would require establishment of minimums for field QC.
- Field surface texture measurement by sand patch test

PHASE II MIX DESIGN PROCEDURE DEVELOPMENT

Task 3 – Evaluation of Potential Test Methods
No Activity

Task 4 – Evaluation of Successful Constructability Indicators
No Activity

Task 5 – Ruggedness Tests of Recommended Equipment and Procedures
No Activity

Task 6 – Phase II Report
No Activity

PHASE III PILOT PROJECTS AND IMPLEMENTATION

Task 7 – Evaluation of Potential Test Methods
No Activity

Task 8 – Workshop Training Program/Pre-Construction Module
No Activity

Task 9 – Pilot Projects/Procedure Validation
No Activity

Task 10 – Final Report
No Activity

PROBLEMS / RECOMMENDED SOLUTIONS

It is possible that the literature review will consume more time and effort than originally estimated. Given the importance of this first task for the project as a whole, it may be necessary to use funds from Phase I, Task 2 to accommodate the increased effort in Phase I, Task 1. This will not affect the overall project costs.

NEXT MONTH'S WORK PLAN

The activities planned for next month are listed below.

- Continue reviewing the documents selected for literature research and acquire the documents currently not available.
- Send revised questionnaires to agencies, industry, and the advisory panel
- Continue development of Phase II and Phase III work plans.

ATTACHMENT A

Videoconference Kickoff Meeting
September 22, 2003
11 am-1 pm PDT

SLURRY/MICRO-SURFACE MIX DESIGN PROCEDURE
PROJECT: RE-0211-01, SPR-3 (073)

VIDEOCONFERENCE KICKOFF MEETING, SEPTEMBER 22, 2003, 11 AM-1 PM PDT

MINUTES

Attendees

CA: Joe Holland, Shakir Shatnawi, Jason Dietz, Gary Hicks; IL: Ron Price, Paul Choudry; KS; Dick McReynolds, Steve Faust, Bill Ballou; MN: Jerry Geib; ND: Jeff Forster; NY: Russ Thielke, Tim Lacoss; VT: Reid Kiniry, Mark Richter; TX: Jim Moulthrop, Dragos Andrei, Jim Travis; DC: Steve Mueller.

Moulthrop Presentation

They are six weeks into the project and the first monthly report has been submitted. Phase 1, which includes a literature review, surveys (industry, states and locals), and work-plans for Phases 2 and 3, will be complete by the end of December. Most of the literature comes from other countries, particularly France and Germany. Equal attention is given to references from all over the world, including France and Germany where slurry seal and microsurfacing systems were developed and used for the first time. Phase 2 is expected to be 18 months and Phase 3 will be a 36-month effort. An advisory board, consisting of material manufacturers, equipment producers, and associations in the industry has been put together. See the attached power point presentation for more details.

State Comments to Presentation

IL: Is the project fully funded? Yes, with funding from Caltrans Maintenance and SP&R programs, Minnesota and New York, the project is fully funded.
KS: There is a need to have sufficient lead-time to get pilot projects identified. There will be some crude guidelines in the Phase 1 report to give the States some ideas for projects.
MN: Are you looking into cement free processes? Cement is a safety issue and a pain because of the process (i.e., people 10-12 feet off of the ground dumping bags into the bins). Many cement-free processes are proprietary.
MN: Would like to see good guidelines for contractor QC and States QA processes.
ND: Page 6 of the monthly report indicates systems used at airports. Are we including airports? Yes, there is a lot to learn from their use on runways and taxiways. It is a small part of the application of this technology.
NY: Who is involved with table 2 of monthly report (surveys)? We will have States portion done via the AASHTO list server.
NY: Can you provide a list of advisory panel members so we can make sure our various local folks are participating? Yes, it will be forward to Caltrans for distribution.
VT: When will we get updates? Monthly as per the Caltrans contract. We will set up a web page, either at Caltrans or via FHWA.
CT: The contract is set up to collect information for short-term evaluations. Will a procedure be set up for how the States should handle long-term evaluations? Yes, the final report will provide a protocol, similar to the LTPP SPS sections, for collecting long-term performance data. Note that long-term is 7-10 years for this technology.
DC: Please include me in future correspondence. Will do.
DC: May want to involve the ALF or NCAT accelerated facilities. This is a possibility. Most of the problems for this technology involve aging and abrading.

State Comments to Survey Questions

IL: Please consider using both list server and regular mail. We can include locals if we can make copies.
KS: How do we address operator errors? Training will be developed to include both States and the contractors.
MN: P 11 of survey, consider expanding question from do you design mixes to do you accept mix designs?
NY: We need to look at constructability issues that affect performance. We shouldn't exclude contractors that don't design their own mixes. We also need to look at types of equipment, for both slurry and micro, in the various parts of the country.

Phase 3 Travel Discussion

CA: There is no funding in the current contract for Fugro to travel to each of the States sponsoring pilot projects.
KS: We really need guidelines at the end of Phase 1 to select projects for the 05/06 construction season.

Phase 3 Future Meetings

KS: We should have a one-day face-to-face meeting at the end of Phase 1 to discuss all of the issues. We will talk to J Sorenson about funds for a Jan-Feb meeting. TRB was discussed, but it was felt that there were too many other things going on at this meeting. One possibility is the late February meeting of ISSA and industry in San Diego. This could afford the opportunity for State DOTs to participate in a conference on the pavement preservation. Another possibility is the chip-seal conference in Sacramento in late January.
All: Face-to-face meetings will be held at the end of Phases 2 and 3. Videoconferences will be used at milestone completions in Phases 2 and 3 (approximately 2-3 milestones per Phase).

Action Items and Close

Get any comments concerning the surveys to J Holland by September 30.

ATTACHMENT B

Survey Comments

SURVEY COMMENTS

Ron Price, ILDOT:

I think it is a good idea to include, as the last item on each survey, space for any other comments or experiences (positive or negative) with slurry/microsurfacing. Maybe someone has something to add that hasn't been brought out from the survey questions.

Regarding the AASHTO LISTSERVE or Agency survey, I would like to hear opinions and expectations from people that are not currently using these products but may be considering them. If you answer NO to #1 the way it is worded now you would not continue with the survey. I would therefore change question 1 to read, "Do you use, or are you considering using". If this change is made to #1 then #4 should read, "If you use or plan to use". Also #9 should then read, "Do you perform or do you plan to perform".

Steve Mueller, FHWA:

I am suggesting that the surveys be reformatted into a "self-scoring format" - it will be quicker to complete, MUCH quicker to compile, and it will enable valid statistical analysis of the data that is collected using a spreadsheet. It will also eliminate nearly all of the data entry errors that go along with other survey formats. I have revised a large portion of the industry survey as an example - but all of the surveys should be modified, and I did not complete the work on the industry survey. There is more for the contractor to do before this is sent out. (See attached document)

Again - I would strongly recommend that more thought be given to the types of information that you are hoping to collect from this survey, and the impacts that you expect this information to have on the research project. It is not clear to me that we are asking all of the questions that we should be asking, or that we are even asking the questions that we have in the right way to get answers that will be valuable to the research. There was a discussion in the monthly report about what things are important -- but the surveys as written don't specifically test all of those things. Don't we want them to?

Also, after reading the surveys, I wonder if it is really necessary to devise separate survey instruments for industry, DOT, and advisory panel members. It might be better just to have them answer different sections of the same document. In general, it is better to have a common baseline for all respondents to allow statistical comparisons between the groups.

Russell Thielke, NYDOT:

General Comment

A section for Additional Comments and/or Concerns should be added to the end of each questionnaire.

Respondents should also be encouraged to provide comments to Yes/No questions if they feel it is necessary to clarify the intent of their response.

Respondents should be encouraged to forward the surveys to others if applicable. For example, states send it to Region/District offices to get perspectives of those that are closer to the actual use of the product (not just the Central Office "spec writer/trouble shooter's" perspective).

A. Comments on Industry Questionnaire

Question 1: Recommend replacing the second sentence with:

> "If YES, continue with Question 2; if NO, skip to Question 8."
>
> (Questions 8-12 could also apply to contractors that place slurry/micro, but do not design the mixes.)

Question 8: Makes it sound like either none or all of the procedures relate to field performance.

Question 9, Question 10: Recommend these questions and rewriting Question 8 as follows:

> "8. In your opinion, which mix design procedures/criteria:
>
> a. Relate to construction and/or long-term performance.
>
> b. Do not relate to construction and/or long-term performance."

B. Comments on States Questionnaire

Question 1: Recommend changing the second sentence to ask a follow-up question:

> "If NO, is there a particular reason why your agency does not use slurry/micro?"

Question 4, Question 5: should be broken down into "categories" to account for different traffic volumes and intersection vs. mainline performance.

Question 7 & Question 8 could be combined as follows:

> "Please identify problems experienced with either system, whether the problem occurred during or after construction, and the frequency of occurrence (infrequent, frequent or always)."
>
> If Questions 7 and 8 are not combined, recommend adding a "BOTH_____" choice to Question 7.

<u>Comments on Advisory Panel Questionnaire</u>

Questions are applicable to contractors not on the Advisory Panel. Suggest merging with the Industry Questionnaire. If not merged, Fugro-BRE should allow the pooled fund States to forward the Industry and Advisory Panel questionnaires to contractors in their States. Fugro-BRE would need to compile all responses to both questionnaires.

ATTACHMENT C

Revised Surveys

CALTRANS PROJECT 65A0151
SLURRY AND MICROSURFACING MIX DESIGN PROCEDURES

Questions for Industry Participants

Please include any comments you might have with your answers. Use a separate sheet of paper if necessary.

You may forward this questionnaire to whomever you feel is appropriate in the interests of this project.

Your input is greatly appreciated. Thank you for your participation in this project.

0 **Background Information**

Name of Company_____

Name of Person Completing Survey_____

Telephone Number_____

Email Address_____

1 Do you design slurry seals and/or microsurfacing systems?

☐ Yes – What design method do you use?

_____

☐ Plan To – What design method are you planning to use?

_____

☐ No – Is there a particular reason why?

_____

2 In what way is the design method you use or plan to use different from the International Slurry Seal Association (ISSA) Procedure?

☐ No difference

☐ Minor Difference – Please explain:

_____

☐ Major Difference – Please explain:

_____

☐ Don't Know – I am not familiar with the ISSA design procedure.

3 In the design method you use or plan to use, are there any test methods and/or procedures that need to be revised or eliminated?

☐ No

☐ Yes – Please list the test method(s) and explain why they should be revised or eliminated:

_____

_____

4 In the design method you use or plan to use, which mix design procedure/criteria relates to construction and/or long-term performance? Please explain why you think there is a relationship to construction and/or long-term performance.

☐ Construction:

_____

_____

_____

☐ Long-term performance:

_____

_____

_____

5 What types of complaints do you receive from your customers:

☐ Most often – Please list:

_____

☐ Least often – Please list:

_____

☐ No complaints

6 What do you try most to control or allow for in field operations, and why?

_____

_____

7 Other comments:

_____

_____

Thank you for your participation. Please send the completed questionnaire by mail/fax/email to:

James Moulthrop, P.E.
FUGRO-BRE, INC.
8613 Cross Park Drive
Austin, Texas 78754
Phone (512) 777-1800
Fax (512) 973-9565
Email: jmoulthrop@fugro.com

CALTRANS PROJECT 65A0151
SLURRY AND MICROSURFACING MIX DESIGN PROCEDURES

Questions for AASHTO LISTSERVE Recipients

Please include any comments you might have with your answers. Use a separate sheet of paper if necessary.

You may forward this questionnaire to whomever you feel is appropriate in the interests of this project.

Your input is greatly appreciated. Thank you for your participation in this project.

0 Background Information

Name of Agency_____

Name of Person Completing Survey_____

Telephone Number_____

Email Address_____

1 Do you currently use or plan to use slurry seals and/or microsurfacing systems on your roadway system?

☐ Yes – How much of each (approximately) have you used in the years noted below (please specify the units used)?

Year	Slurry Seal, yd^2 or tons	Microsurfacing, yd^2 or tons
2002		
2001		
2003		

☐ Plan to use in the future?

_____

☐ No – Is there a particular reason why?

_____

2 If you currently use these systems, do you expect to continue to use them? Please explain why:

☐ Yes _____

☐ No _____

3 What is your experience/expectations regarding the service life of slurry seals and microsurfacing systems (how long do you expect them to last)? Include traffic volume, intersection vs. mainline, and other details, if needed:

Service Life (years):	**Slurry Seals**	**Microsurfacing**
From Past Experience:		
Expected:		

Other Comments:

_____

4 Have you experienced any performance problems with slurry and microsurfacing systems <u>during</u> construction?

Frequency	**Slurry Seals**	**Microsurfacing**
Most often:		
Least often:		

5 Have you experienced any performance problems with slurry and microsurfacing systems <u>after</u> construction?

Frequency	**Slurry Seals**	**Microsurfacing**
Most often:		
Least often:		

6 Do you perform any QA testing and evaluation on these systems? Please explain:

☐ For microsurfacing:

_____

☐ For slurry seals:

_____

☐ No QA

7 Other comments:

_____

_____

Thank you for your participation. Please send the completed questionnaire by mail/fax/email to:

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CALTRANS PROJECT 65A0151
SLURRY AND MICROSURFACING MIX DESIGN PROCEDURES

Questions for Advisory Panel Contractors

Please include any comments you might have with your answers. Use a separate sheet of paper if necessary.

You may forward this questionnaire to whomever you feel is appropriate in the interests of this project.

Your input is greatly appreciated. Thank you for your participation in this project.

0 Background Information

Name of Company_____

Name of Person Completing Survey_____

Telephone Number_____

Email Address_____

1 Please indicate who designs your slurry seal and microsurfacing mixtures:

- ☐ Private testing laboratory
- ☐ Emulsion supplier
- ☐ Other:_____

2 What are the biggest areas of complaint from your customers?

- ☐ Service life
- ☐ Traffic time
- ☐ Adaptability to conditions
- ☐ Other:_____

3 Do the slurry seal and microsurfacing mix design provided to you satisfy your requirements in terms of being able to mix, place, and finish the system? Please indicate below (Yes/No):

	Slurry Seals	**Microsurfacing**
Mix		
Place		
Finish		

4 Do you make adjustments to the mix design in the field? Please indicate the reasons below:

☐ Adjustments to slurry seals:

_____

☐ Adjustments to microsurfacing:

_____

5 Have you encountered problems reproducing the laboratory mix design in the field?

☐ Yes, with slurry seal:

_____

☐ Yes, with microsurfacing:

_____

☐ No

6 Other comments:

_____

_____

Thank you for your participation. Please send the completed questionnaire by mail/fax/email to:

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